SECTION A–46 MARKS
ATTEMPT ALL QUESTIONS IN THIS SECTION.

1. (a). Complete the following equations for the nuclear reactions.

   i. $^{27}_{14}Si \longrightarrow {}^{27}_{13}Al + \ldots\ldots\ldots\ldots\ldots\ldots$ (01 mark)

   ii. $^{241}_{95}Am + {}^{4}_{2}He \longrightarrow {}^{243}_{97}Bk + \ldots\ldots\ldots\ldots$ (01 mark)

   iii. $^{238}_{92}U + {}^{1}_{0}n \longrightarrow {}^{239}_{93}Np + \ldots\ldots\ldots\ldots$ (01 mark)

   (b). In an experiment, the rate of radioactive decay of bromine decreased by **25%** in **96** minutes. Calculate the **half-life** of bromine. (02 marks)

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2. An alkene **R**, diffuses through a porous partition in **2** minutes. Under similar conditions, the same volume of oxygen gas diffuses in **1.75** minutes.

   a) (i). Calculate the **formula mass** of **R**. (01½ marks)

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(ii). Determine the **molecular formula** of **R**. (02 marks)

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b) Write equations to show how **R** can be **synthesized** from **propanone**. (02 marks)

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3. In the manufacture of sulphuric acid, sulphur trioxide is **not** dissolved in water, but another solvent.

a) (i). State why water is **not** used as a solvent. (01 mark)

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(ii).Write equation(s) to show the formation of sulphuric acid from sulphur trioxide gas. (03 marks)

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b) Write equation for the reaction between sulphuric acid and hydrogen bromide. (01½ marks)

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4. (a) State **one** colligative property of a dilute solution other than depression of freezing point or elevation of boiling point of a solvent. (01 mark)

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(b) Ethane-1, 2-diol $HOCH_2CH_2OH$, is used as an antifreeze for water in car radiators. **Calculate** the **mass of ethane-1, 2-diol** that should be added to **1kg** of water to prevent it from freezing at **-10°C**. (03 marks)

[Freezing point depression constant for water = **1.86°Ckgmol^{-1}**]

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Nylon–6, 6, $\left\{ N-(CH_2)_6\, NHCO\,(CH_2)_4\, C \right\}_n$ is a synthetic polymer formed by condensation polymerisation.

5. (a). State what is meant by the term **condensation polymerization**. (01 mark)

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(b). Write the **structural formulae** of the monomers of **nylon-6, 6**. (01 mark)

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(c).Name:

i. **One natural polymer** that is formed by condensation polymerization. (01 mark)

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ii. The **monomers** of the polymer in (c) (i). (0½ mark)

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(d).State **one** use of the polymer you have named in (c) (i). (0½ mark)

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6. (a). State two properties in which chromium behaves as a transition element. (01 mark)

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(b). Write the equation for the reaction that takes place when chromium (III) sulphate is dissolved in water. (01½ marks)

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(c). Magnesium ribbon was added to a solution of chromium (III) sulphate.

i. State what was observed. (01 mark)

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ii. Write equation for the reaction that took place. (01½ marks)

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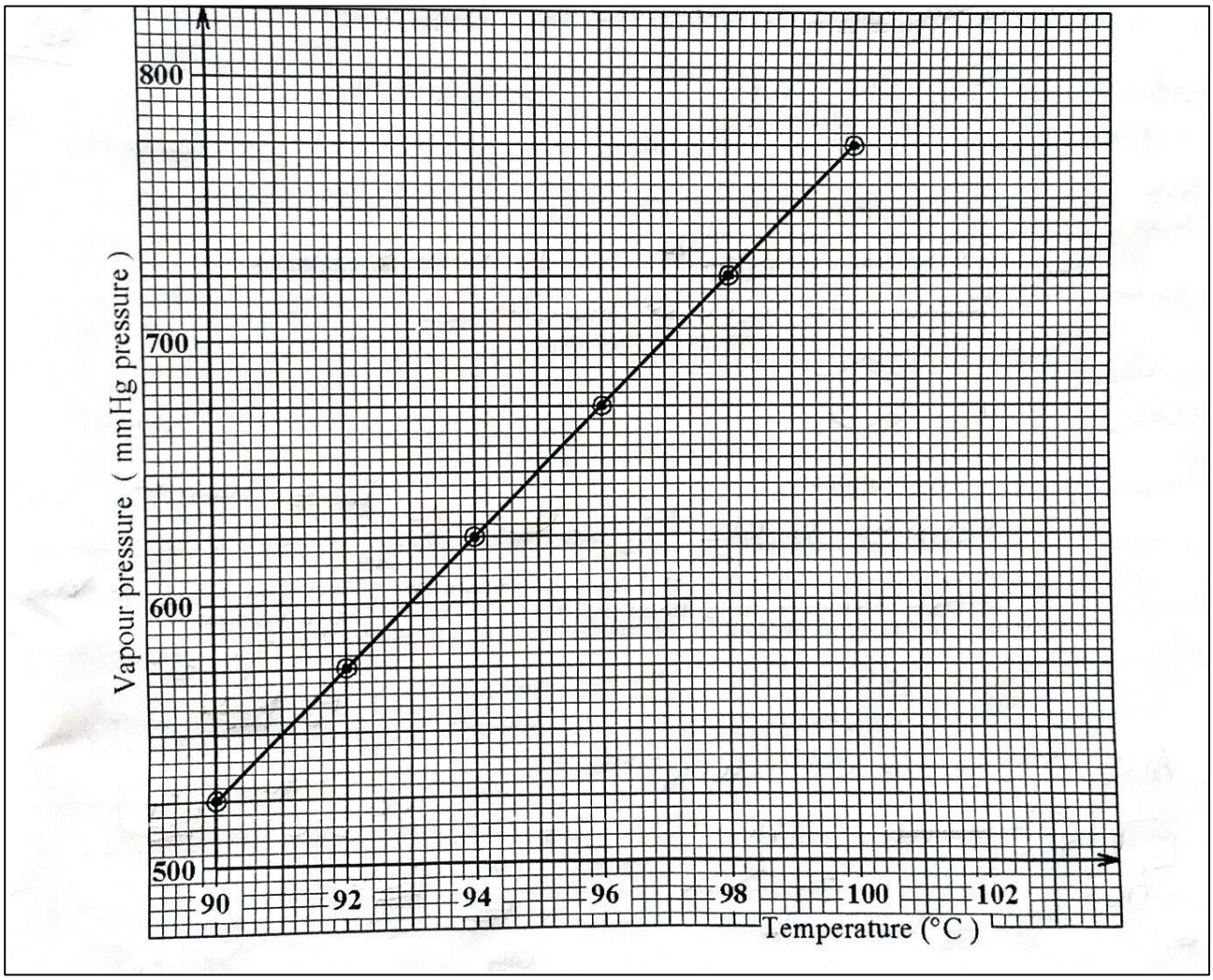
7. The graph below shows how the total vapour pressure of a mixture of water and nitrobenzene varies with temperature.



a) State the temperature at which the mixture boils at **760mmHg** pressure. (01 mark)

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b) The partial vapour pressure of nitrobenzene at the boiling point of the mixture is **20mmHg**.
Calculate the **percentage of nitrobenzene by mass** that will be obtained when the mixture is steam distilled at normal atmospheric pressure. (H = 1, C = 12, N = 14, O = 16) (04 marks)

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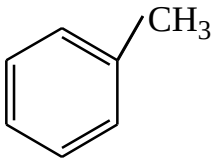
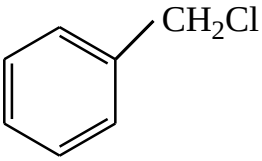
8. (a). State the condition(s) under which the following conversions can be effected.

i).  to  (01½ marks)

Conditions:

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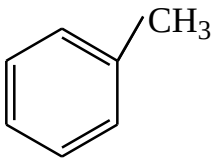
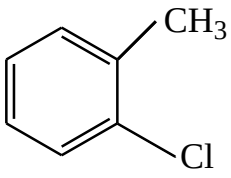
ii).  to  (01½ marks)

Conditions:

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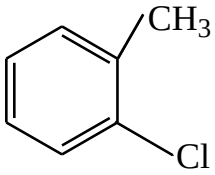
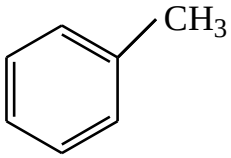
(b). Write a mechanism for the reaction leading to the formation of:

 From  (02 marks)

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9. Explain the following observations.
   a) Silicon (IV) chloride is **hydrolyzed** by **water** while carbon tetrachloride is **not**. (03½ marks)

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b) Lead (IV) chloride **exists** but lead (IV) bromide **does not**. (02 marks)

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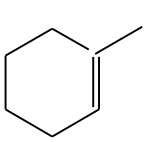
SECTION B–54 MARKS

ATTEMPT ANY SIX QUESTIONS IN THIS SECTION.

10. Complete each of the following equations and write the suggested mechanism for the reaction.

a)  ..... (02½ marks)

Mechanism:

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b) $CH_3COBr \xrightarrow[\text{Heat}]{CH_3CH_2NH_2}$ ..... (03½ marks)

Mechanism:

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c) $HCHO \xrightarrow{KCN/H^{+}_{(aq)}}$ …… (03 marks)

Mechanism:

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11.(a). State what is meant by the term **buffer solution**. (01 mark)

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(b). Calculate the **pH** of the solution formed when **0.61g** of benzoic acid is dissolved in **1dm³** of a **0.02M** sodium benzoate. (02½ marks)
(**Ka** of benzoic acid = **6.3×10^{-5} moldm^{-3}**)

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(c). Explain what would happen to the **pH of the solution in (b)** if a few drops of the following reagents were added:

i. Potassium hydroxide solution. (03 marks)

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ii. Hydrochloric acid. (02½ marks)

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12.(a). When **0.1g** of aluminium chloride was vaporized at **350°C** and pressure of **1atmosphere**, **19.2cm³** of vapour was formed.

i. Calculate the **relative molecular mass** of aluminium chloride. (02 marks)

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ii. Write the **molecular formula** of aluminium chloride in the gaseous state at **350°C**. (Al = 27, Cl = 35.5) (01 mark)

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(b). Aluminium chloride is normally contaminated by traces of iron (III) chloride.

i. Name **one reagent** that can be used to detect the presence of iron (III) ion in a contaminated solution of aluminium chloride. (01 mark)

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ii. State what would be observed if the contaminated aluminium chloride solution was treated with the named reagent in (b) (i). (0½ mark)

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iii. Write equation for the reaction leading to the observation you have stated in (b) (ii). (01½ marks)

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(c). Water was added drop wise to aluminium chloride.

i. State what was observed. (01 mark)

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ii. Write equation for the reaction that took place. (01½ marks)

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(d).State **one use** of aluminium chloride in organic synthesis. (0½ mark)

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13.(a). Draw the structure and name the shape of each of the species in the table below. (04½ marks)

Species	Structure	Shape
BF_3		
$SnCl_2$		
ClO_3^-		

(b). Write equation for the reaction between:

i. Boron trifluorude and ammonia. (01½ marks)

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ii. Tin (II) chloride and iron (III) ions. (01½ marks)

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iii. Acidified potassium iodide solution and aqueous sodium chlorate (V) solution. (01½ marks)

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14.(a). Write:

i. Equation for the **ionization** of methanoic acid in water. (01½ marks)

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ii. The **expression** for the acid dissociation constant Ka, for methanoic acid. (01 mark)

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(b). The molar conductivities of some electrolytes at infinite dilute at **25°C** are given in the table below.

Electrolyte	molar conductivity at infinite dilution (**Scm^2/mol**)
Sodium chloride	113.0
Sodium methanoate	101.0
Sodium hydroxide	225.2
Hydrochloric acid	397.8

Calculate the **molar conductivity** of methanoic acid at infinite dilution. (03 marks)

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(c). The molar conductivity of a **0.05M** methanoic acid solution is **24.328Scm²/mol** at **25°C**.
Calculate the:

i. Degree of **ionization** of methanoic acid at **25°C**. (01½ marks)

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ii. Dissociation constant **Ka** of methanoic acid at **25°C**.(02 marks)

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15.Name **one functional group** that can be identified using each of the following reagents. In each case state what would be **observed** and write **equation** for the reaction that would take place:

a) Bromine water:

Functional group. (01 mark)

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Observation. (01 mark)

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Equation. (01 mark)

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b) 2, 4-dinitrophenyl hydrazine.

Functional group. (01 mark)

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Observation. (01 mark)

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Equation. (01 mark)

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c) Sodium carbonate.

Functional group. (01 mark)

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Observation. (01 mark)

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Equation. (01 mark)

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16. During the extraction of copper from copper pyrites, copper pyrites is crushed and agitated with water/oil mixture. Compressed air is bubbled through the mixture which is then filtered, roasted and finally impure molten copper is obtained.

a) State the role of:

i. Oil. (01 mark)

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ii. Compressed air. (01 mark)

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b) Write equation for the reaction that occurs when copper pyrites is roasted. (01½ marks)

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c) Explain briefly how impure copper can be refined. (04 marks)

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d) Explain why it is advantageous to have a sulphuric acid manufacturing plant near a copper extraction plant. (01½ marks)

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17.(a). State what is meant by the term:

i. Order of a reaction. (01 mark)

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ii. Half-life of a reaction. (01 mark)

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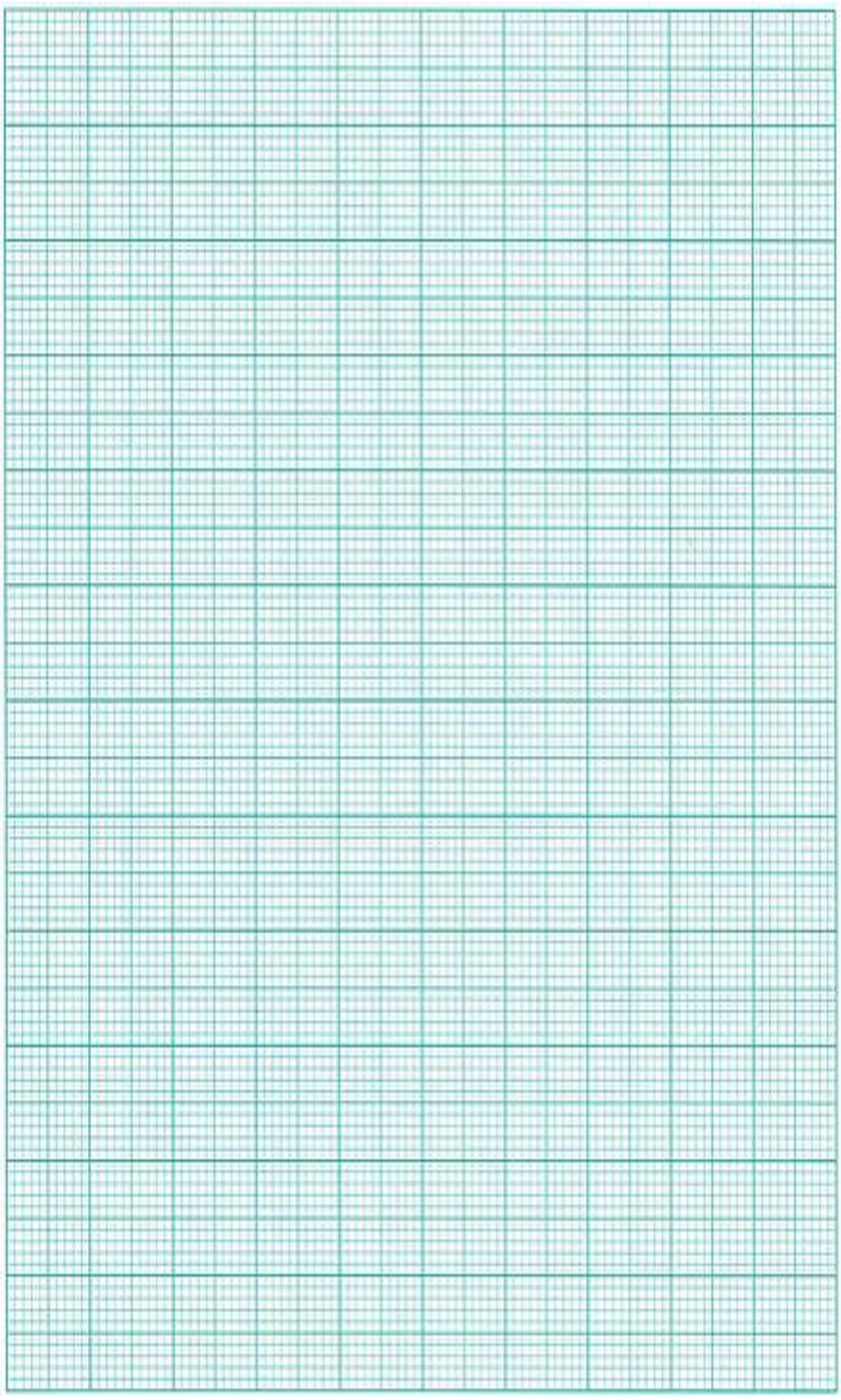
(b). The table below shows the kinetic data obtained for the hydrolysis of methyl ethanoate in acidic media.

$[CH_3COOCH_3](mol/dm^3)$	0.241	0.161	0.109	0.073	0.046	0.034
Time (minutes)	0	60	120	180	240	320

Plot a graph of **concentration** of methyl ethanoate **against time**.

(03arks)



(c).Use the graph in (b) above to determine the:

i. Half-life of the reaction. (01½ marks)

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ii. Order of the reaction with respect to CH_3COOCH_3.Give a reason for your answer. (01 mark)

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(d).Calculate the **rate constant** and indicate its **units**. (01½ marks)

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THE PERIODIC TABLE

1	2											3	4	5	6	7	8
1.0 H 1																1.0 H 1	4.0 He 2
6.9 Li 3	9.0 Be 4											10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12											27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 TI 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

♥ ===END===

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This is the last page of the printed paper, Page 20